

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appeal No. _____

Application No.: 10/812,626

Filing Date: March 29, 2004

Appellants: Bradley C. Aldrich et al.

Conf. No.:

Group Art Unit: 2625

Examiner: Iriana Cruz

Title: LOOK-UP TABLE FOR TRANSFER FUNCTION

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APPEAL BRIEF

This brief on appeal is submitted pursuant to the Notice of Appeal filed in the U.S. Patent and Trademark Office on March 29, 2010 and in response to the Final Office Action mailed December 29, 2009.

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I. REAL PARTY IN INTEREST

The real party in interest is Marvell International Ltd. by virtue of assignments recorded in the Patent and Trademark Office at Reel 015188, Frame 0913 and Reel 018515, Frame 0817.

RELATED APPEALS AND INTERFERENCES

The Assignee, the Appellants, and the undersigned do not know of any other appeals, interferences, or judicial proceedings that would directly affect or that would be directly affected by, or have a bearing on, the Board's decision in this Appeal.

II. STATUS OF THE CLAIMS

Claims 1-18, 24-27, and 32-34 are pending and stand rejected.

Claims 19-23 and 28-37 are cancelled.

Appellants appeal the rejection of claims 1-18, 24-37, and 32-34.

III. STATUS OF THE AMENDMENTS

The claims have not been amended subsequent to the Final Office Action, and there are no un-entered amendments.

IV. SUMMARY OF THE CLAIMED SUBJECT MATTER

Independent claim 1 recites an image processing device (e.g., image processing device 100, FIG. 1; see Page 5, Lines 3-4) comprising a look-up table (LUT) (e.g., LUTs 124, FIG. 2; see Page 8, Line 2) storing sample outputs from an output range of a transfer function, wherein the transfer function maps sample inputs from an input range of the transfer function to the sample outputs (see Page 6, Lines 1-10), and wherein, based on a curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function (FIGS. 3 and 4; see Page 10, Lines 10-16). An address module calculates an index into the LUT based on image data (e.g., address module 122, FIG. 2; see Page 8, Lines 5-6).

Independent claim 11 recites a digital camera (e.g., image processing device 100, FIG. 1; see Page 5, Lines 3-9) for capturing digital video or still images, the digital camera comprising a sensor (e.g., sensor 102, FIG. 1; see Page 5, Lines 11-12) to convert light into image data. A look-up table (LUT) (e.g., LUTs 124, FIG. 2; see Page 8, Line 2) storing sample outputs from an output range of an image processing transfer function, wherein the image processing transfer function maps sample inputs from an input range of the image processing transfer function to the sample outputs (see Page 6, Lines 1-10), and wherein, based on a curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the image processing transfer function than a second region of the image processing transfer function (FIGS. 3 and 4; see Page 10, Lines 10-16). A battery powers the sensor and the LUT.

Independent claim 24 recites a method comprising receiving image data, the image data being input for a transfer function, the transfer function mapping an input range to an output range (see Page 6, Lines 1-10), using a first section of the received image data to identify a region of the input range of the transfer function to which the received image data belongs (as shown in FIG. 6; see Page 11, Lines 5-6), selecting a second section of the received image data based on the identified region (e.g., see Page 11, Lines 6-9), addressing an entry of a look-up table (LUT) (e.g., LUTs 124, FIG. 2; see Page 8, Line 2) using the first and second sections of the image data (e.g., see Page 12, Lines 2-7), and calculating a transferred image data by using the addressed entry and a residual section of the image data (e.g., see Page 12, Lines 2-16).

Independent claim 32 recites a machine-readable medium that stores data representing instructions that, if accessed by a processor (e.g., see Page 13, Line 20 through Page 14, Line 2), will cause the processor to receive image data, the image data being input for a transfer function, the transfer function mapping an input range to an output range (see Page 6, Lines 1-10), use a first section of the received image data to identify a region of the input range of the transfer function to which the received image data belongs (as shown in FIG. 6; see Page 11, Lines 5-6), select a second section of the received image data based on the identified region (e.g., see Page 11, Lines 6-9), index an entry of a look-up table (LUT) (e.g., LUTs 124, FIG. 2; see Page 8, Line 2) using the first and second sections of the image data (e.g., see Page 12, Lines 2-7), calculate a transferred image data by using the addressed entry and a residual section of the image data (e.g., see Page 12, Lines 2-16).

V. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Appellants seek the Board's review of:

- (a) whether claims 1-11, 24-27, and 32-34 are unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 5,600,574 ("Reitan") in view of U.S. Pub. No. 2005/0057303 A1("Leffel").
- (b) whether claim 11 is unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 5,600,574 ("Reitan") in view of U.S. Pub. No. 2002/0030751 A1("Takane").
- (c) whether claim 12-18 are unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 5,600,574 ("Reitan") in view of U.S. Pub. No. 2002/0030751 A1("Takane") and in further view of U.S. Pub. No. 2005/0057303 A1 ("Leffel").

VI. ARGUMENTS**A. Rejection under 35 U.S.C. § 103(a) over over U.S. Patent No. 5,600,574 ("Reitan") in view of U.S. Pub. No. 2005/0057303 A1("Leffel")****1. Claims 1-11, 24-27, and 32-34**

Claim 1 recites an image processing device including a look-up table. The look-up table stores sample outputs from an output range of a transfer function, in which the transfer function maps sample inputs (from an input range of the transfer function) to the sample outputs.

Based on the curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function.

(a) Reitan fails to disclose that, based on a curvature of a transfer function, sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function, as recited in Claim 1

In rejecting claim 1, the Examiner alleges that Reitan discloses sample inputs being distributed based on a curvature of the transfer function at Column 16, Lines 8-17, Column 21, Lines 55-67, Column 22, Lines 5-10, and FIGS. 9-11, and notes "the response curve of the transfer function." (See Page 4 of the Office Action mailed December 29, 2009, hereinafter "the Office Action"). Appellants respectfully note that each of these cited portions is absent of any teaching or suggestion whatsoever that sample inputs are distributed so that more sample inputs are associated with a first region of the transfer

function than a second region of the transfer function specifically **based on the curvature of the transfer function.**

For example, Column 16, Lines 8-17 recite:

To test for pixel value integrity, an image containing a broad range of densities is required such as that described above in conjunction with FIG. 6 which corresponds to reference film 405 described above in conjunction with FIG. 4A. A sufficient number of sample points on reference film 405 is required to reveal any nonlinearities over small ranges of input values. To measure the uniformity of response, the input regions of equal density should be as uniform as possible.

Appellants respectfully note that this portion of Reitan fails to disclose sample inputs distributed based on the curvature of a transfer function, and in fact is absent of any teaching or suggestion of a transfer function. Accordingly, this portion of Reitan fails to disclose distributing more sample inputs in a first region of the transfer function than in a second region of the transfer function based on the curvature of the transfer function.

Conversely, Column 21, Lines 55-67 of Reitan merely state that look up tables are utilized "to achieve a desired transfer function." In other words, the look up tables are used to determine the transfer function. In contrast, claim 1 recites that the sample inputs are distributed based on the curvature of the transfer function. This portion of Reitan is absent of any teaching or suggestion that the sample inputs are distributed based on the curvature of the transfer function, and instead discloses only that lookup tables are utilized **to achieve** a desired transfer function.

Similarly, Column 22, Lines 5-10 of Reitan merely disclose that LUTs "are used to transform pixel quantities" without disclosure as to how a number of sample inputs are distributed

based on **the curvature** of the transfer function. FIGS. 9-11 are merely graphical representations of the LUTs, not an indication that more or less sample inputs are distributed in particular areas based on the curvature of the transfer function.

Instead, Reitan discloses regions of interest in the actual image "defined within bar spacing regions so that the region of interest stays completely within these features." (See Column 18, Lines 20-30). In other words, Reitan discloses locating a specific region of the image to be sampled and populating a look up table accordingly. As such, sample inputs are distributed based on a region of the image, not a curvature of the transfer function. Appellants respectfully submit that distributing sample inputs **based on an image region** is not analogous to distributing the sample inputs based on **the curvature of the transfer function**. In particular, Appellants respectfully submit that determining sample inputs based directly on an image region does not even require the formation of a transfer function. Accordingly, Reitan fails to disclose that the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function.

(b) Leffel fails to disclose that, based on a curvature of a transfer function, sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function, as recited in Claim 1

The Examiner merely relies on Leffel to disclose an address module to calculate an index into the LUT based on image data, and a sensor, respectively. Although Appellants do not concede that Leffel discloses these limitations, Appellants respectfully submit that Leffel fails make up for the deficiencies of Reitan

with respect to the recitation that, based on a curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function.

(c) The Examiner has failed to establish a *prima facie* case of obviousness

To establish a *prima facie* case of obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations. See, e.g., *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Reitan and Leffel clearly fail to disclose that, based on the curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function. Consequently, the combination of Reitan and Leffel cannot render claim 1 obvious.

In view of the foregoing, Appellants respectfully submit that claim 1 is in condition for allowance for at least the above reasons.

(d) Remaining Claims

Independent claims 11, 24, and 32 include similar limitations and are therefore allowable for at least similar reasons as claim 1.

Dependent claims 2-10, 12-18, 25-27, and 33-34 ultimately depend from claims 1, 11, 24, and 32 and are therefore allowable for at least similar reasons.

Appellants' position with respect to claims 2-10, 12-18, 25-27, and 33-34 should not be understood as implying that no other reasons for the patentability of claims 2-10, 12-18, 25-

27, and 33-34 exist. Appellants reserve the right to address these other reasons at a later date if needed.

B. Rejection under 35 U.S.C. § 103(a) over U.S. Patent No. 5,600,574 ("Reitan") in view of U.S. Pub. No. 2002/0030751 A1 ("Takane")

1. Claim 11

Claim 11 recites that, based on the curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function.

(a) Reitan fails to disclose that, based on a curvature of a transfer function, sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function, as recited in Claim 11

In rejecting claim 11, the Examiner alleges that Reitan discloses the sample inputs being distributed based on a curvature of the transfer function at Column 16, Lines 8-17, Column 21, Lines 55-67, Column 22, Lines 5-10, and FIGS. 9-11, and notes "the response curve of the transfer function." (See Page 10 of the Office Action mailed December 29, 2009, hereinafter "the Office Action"). Appellants respectfully note that each of these cited portions is absent of any teaching or suggestion whatsoever that the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function specifically **based on the curvature of the transfer function**.

For example, Column 16, Lines 8-17 recite:

To test for pixel value integrity, an image containing a broad range of densities is required such

as that described above in conjunction with FIG. 6 which corresponds to reference film 405 described above in conjunction with FIG. 4A. A sufficient number of sample points on reference film 405 is required to reveal any nonlinearities over small ranges of input values. To measure the uniformity of response, the input regions of equal density should be as uniform as possible.

Appellants respectfully note that this portion of Reitan fails to disclose that sample inputs are distributed based on the curvature of the transfer function, and in fact is absent of any teaching or suggestion of a transfer function. Accordingly, this portion of Reitan fails to disclose distributing more sample inputs in a first region of the transfer function than in a second region of the transfer function based on the curvature of the transfer function.

Conversely, Column 21, Lines 55-67 of Reitan merely state that look up tables are utilized "to achieve a desired transfer function." In other words, the look up tables are used to determine the transfer function. In contrast, claim 1 recites that the sample inputs are distributed based on the curvature of the transfer function. This portion of Reitan is absent of any teaching or suggestion that the sample inputs are distributed based on the curvature of the transfer function and instead discloses that lookup tables are utilized **to achieve** a desired transfer function.

Similarly, Column 22, Lines 5-10 of Reitan merely disclose that LUTs "are used to transform pixel quantities" without disclosure as to how a number of sample inputs are distributed based on **the curvature** of the transfer function. FIGS. 9-11 are merely graphical representations of the LUTs, not an indication that more or less sample inputs are distributed in particular areas based on the curvature of the transfer function.

Instead, Reitan discloses regions of interest in the actual image "defined within bar spacing regions so that the region of interest stays completely within these features." (See Column 18, Lines 20-30). In other words, Reitan discloses locating a specific region of the image to be sampled and populating a look up table accordingly. As such, sample inputs are distributed based on a region of the image, not a curvature of the transfer function. Appellants respectfully submit that distributing sample inputs **based on an image region** is not analogous to distributing the sample inputs based on **the curvature of the transfer function**. In particular, Appellants respectfully submit that determining sample inputs based directly on an image region does not even require the formation of a transfer function. Accordingly, Reitan fails to disclose that the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function.

(b) Takane fails to disclose that, based on the curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function as recited in Claim 11

The Examiner merely relies on Takane to disclose a digital camera comprising a sensor to convert light into image data. Although Appellants do not concede that Takane discloses these limitations, Appellants respectfully submit that Takane fails make up for the deficiencies of Takane with respect to the recitation that, based on a curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function.

(c) The Examiner has failed to establish a *prima facie case of obviousness*

To establish a *prima facie case of obviousness*, the prior art reference (or references when combined) must teach or suggest all the claim limitations. See, e.g., *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Reitan and Takane clearly fail to disclose that, based on the curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function. Consequently, the combination of Reitan and Leffel cannot render claim 11 obvious.

In view of the foregoing, Appellants respectfully submit that claim 11 is in condition for allowance for at least the above reasons.

C. Rejection under 35 U.S.C. § 103(a) over U.S. Patent No. 5,600,574 ("Reitan") in view of U.S. Pub. No. 2002/0030751 A1 ("Takane") and in further view of U.S. Pub. No. 2005/0057303 A1 ("Leffel")

1. Claims 12-18

Leffel and Takane do not remedy the deficiencies of Reitan with respect to claim 11, from which claims 12-18 depend. Therefore, claims 12-18 are in condition for allowance for at least similar reasons as claim 11.

Appellants' position with respect to claims 12-18 should not be understood as implying that no other reasons for the patentability of claims 12-18 exist. Appellants reserve the right to address these other reasons at a later date if needed.

CONCLUSION

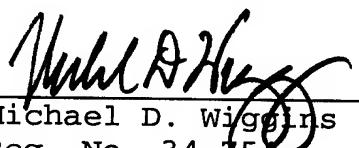
Appellants respectfully request the Board to reverse the Examiner's rejection of the claims on appeal.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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VII. CLAIMS APPENDIX

This is a complete and current listing of the claims.

1. (Previously Presented) An image processing device comprising:

a look-up table (LUT) storing sample outputs from an output range of a transfer function, wherein the transfer function maps sample inputs from an input range of the transfer function to the sample outputs, and wherein, based on a curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the transfer function than a second region of the transfer function; and

an address module to calculate an index into the LUT based on image data.

2. (Original) The image processing device of claim 1, further comprising an interpolation module to calculate transferred image data using the sample output in the LUT addressed by the index.

3. (Original) The image processing device of claim 1, further comprising a plurality of additional LUTs, one LUT to correspond to each color channel used by a color space.

4. (Original) The image processing device of claim 3, further comprising a color filter to determine a color of the image data and to select one of the plurality of LUTs based on the determined color.

5. (Original) The image processing device of claim 2, wherein the interpolation module also uses the image data to calculate the transferred image data.

6. (Original) The image processing device of claim 1, wherein the address module calculates the index by accessing a region pointer based on a first part of the image data, and combining the region pointer with a second part of the image data.

7. (Original) The image processing device of claim 6, wherein the first part of the image data comprises the first two bits of the image data that determine a quartile, the region pointer comprises a quartile pointer that addresses the first sample output mapped from a sample input in the quartile, and the second part of the image data indicates the address of the indexed sample output within the quartile.

8. (Original) The image processing device of claim 6, wherein the transfer function has four regions, the first and second regions each being one of the four regions, and the region pointer identifies with which of the four regions the image data is associated.

9. (Original) The image processing device of claim 2, wherein the transferred image data comprises companded image data.

10. (Original) The image processing device of claim 2, wherein the transferred image data comprises gamma-corrected image data.

11. (Previously Presented) A digital camera for capturing digital video or still images, the digital camera comprising:

a sensor to convert light into image data;

a look-up table (LUT) storing sample outputs from an output range of an image processing transfer function, wherein the image processing transfer function maps sample inputs from an input range of the image processing transfer function to the sample outputs, and wherein, based on a curvature of the transfer function, the sample inputs are distributed so that more sample inputs are associated with a first region of the image processing transfer function than a second region of the image processing transfer function; and

a battery to power the sensor and the LUT.

12. (Original) The digital camera of claim 11, further comprising an address module to calculate an index into the LUT based on image data.

13. (Original) The digital camera of claim 12, further comprising an interpolation module to calculate transferred image data using the image data and the sample output in the LUT addressed by the index.

14. (Original) The digital camera of claim 11, further comprising a plurality of additional LUTs, one LUT to correspond to each color channel used by a color space.

15. (Original) The digital camera of claim 14, further comprising a color filter to determine a color of the image data and to select one of the plurality of LUTs based on the determined color.

16. (Original) The digital camera of claim 12, wherein the address module calculates the index by accessing a region pointer based on a first part of the image data, and combining the region pointer with a second part of the image data.

17. (Original) The digital camera of claim 16, wherein the transfer function has four regions, the first and second regions each being one of the four regions, and the region pointer identifies with which of the four regions the image data is associated.

18. (Original) The digital camera of claim 11, wherein the image processing transfer function comprises a gamma-correction transfer function.

19-23. (Cancelled)

24. (Original) A method comprising:
receiving image data, the image data being input for a transfer function, the transfer function mapping an input range to an output range;

using a first section of the received image data to identify a region of the input range of the transfer function to which the received image data belongs;

selecting a second section of the received image data based on the identified region;

addressing an entry of a look-up table (LUT) using the first and second sections of the image data; and

calculating a transferred image data by using the addressed entry and a residual section of the image data.

25. (Original) The method of claim 24, wherein selecting a second section of the received image data comprises selecting a number of bits able to identify each entry of the LUT associated with the identified region.

26. (Original) The method of claim 25, wherein addressing the entry of the LUT comprises accessing a pointer identifying a set of entries of the LUT associated with the identified region, and using the selected number of bits of the second section to identify one of the set of entries.

27. (Original) The method of claim 24, wherein calculating the transferred image data comprises interpolating between the addressed entry and an adjacent entry using the residual section of the image.

28-31. (Cancelled)

32. (Original) A machine-readable medium that stores data representing instructions that, if accessed by a processor, will cause the processor to receive image data, the image data being input for a transfer function, the transfer function mapping an input range to an output range, use a first section of the received image data to identify a region of the input range of the transfer function to which the received image data belongs, select a second section of the received image data based on the identified region, index an entry of a look-up table (LUT) using the first and second sections of the image data, calculate a transferred image data by using the addressed entry and a residual section of the image data.

33. (Original) The machine-readable medium of claim 32, wherein the instructions are such that the selection of the second section of the received image data comprises selecting a number of bits able to identify each entry of the LUT associated with the identified region.

34. (Original) The machine-readable medium of claim 33, wherein the instructions are such that the indexing of the entry of the LUT comprises accessing a pointer identifying a set of entries of the LUT associated with the identified region, and using the selected number of bits of the second section to identify one of the set of entries.

VIII. EVIDENCE APPENDIX

None

IX. RELATED PROCEEDINGS APPENDIX

None

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